Appendix C. Clean Energy Supply: Technologies, Markets, and Programs

This appendix provides an overview of the benefits of clean energy supply technologies, including renewable energy (i.e., wind, solar photovoltaics [PV], solar thermal, wind, biomass, geothermal, waste-to-energy, and landfill gas/biomass) and combined heat and power (CHP). It describes the key market issues and challenges related to developing these technologies and concludes with an overview of some of the emerging and innovative approaches that states can pursue to foster clean energy supply in their states.

Benefits of Clean Energy Supply

States are developing initiatives and taking actions aimed at bringing reliable sources of energy to the marketplace. State and local governments are finding that clean energy supply technologies have significant economic and environmental benefits, and therefore enjoy widespread public support. These benefits include:

- *Increased State Economic Development.* Clean energy technologies can promote economic development in a variety of ways. Clean energy projects create short-term construction and installation jobs and provide numerous long-term opportunities associated with new clean energy businesses. Alternative energy sources reduce fuel price volatility and increase fuel diversity, leading to a more stable energy supply portfolio that can be an important component of new economic growth. Renewable energy draws on local resources that can offset imports from out-of-state. Use of these in-state resources improves the state balance of trade and can create long-term economic value.
- *Reduced Energy-Related Environmental Pollution.* CHP reduces the amount of fuel input per unit of energy output and reduces the corresponding emissions of pollutants and greenhouse gases. Electricity from renewable resources generally does not contribute to global climate change or local air pollution. In particular, air emissions associated with generating electricity from solar, geothermal, and wind technologies are negligible, because no fuels are combusted in these processes. Producing electricity from LFG and biogas avoids the need to use nonrenewable resources to produce electricity.
- *Increased Power Reliability.* CHP and renewable energy, as distributed generation (DG), reduce electricity infrastructure vulnerability. DG facilities can help reduce congestion on the electric grid by removing or reducing load in areas of high demand. They can also be operated independently of the grid in the event of a disruption to central systems.
- *Increased Fuel Diversity.* Increased fuel diversity avoids over-reliance on a single fuel, which can cause disruption or price volatility if the supply of that fuel is constrained. Renewable energy technologies broaden the energy mix. CHP can use a variety of fuels, including natural gas, coal, biomass, and biogas.
- *Efficient Use of Natural Resources.* CHP requires less fuel for a given energy output, so it reduces the demand for finite natural resources, such as natural gas and coal. The average efficiency of fossil-fueled power plants in the United States is 33% and has remained virtually unchanged for 40 years. When purchased electricity is combined with onsite thermal generation (assuming 80% boiler efficiency), the typical combined efficiency is 49%. CHP systems typically achieve overall fuel efficiencies of 55% to 80% and reduce fuel use 20% to 50% over separate heat and power.

This improvement in efficiency is an excellent pollution prevention strategy that reduces emissions of air pollutants and carbon dioxide, the leading greenhouse gas associated with climate change. Furthermore, since CHP is located at the energy user's site, it reduces electric transmission and distribution losses (averaging 7% to10%), resulting in further efficiency gains and providing an efficient use of natural resources (e.g., coal and natural gas) through a highly optimized system producing two or more useful outputs from one fuel input. The use of renewable energy sources reduces fossil fuel consumption even further; unlike fossil fuels, renewable energy sources are sustainable and will not run out.

Clean Energy Technologies

A wide range of clean energy technologies can be used to generate electricity. Table C.1 compares key clean energy technologies. The remainder of this section presents a brief description of each technology.

Wind Power

Wind power is currently one of the most economically viable renewable energy resources. Key advantages include its relatively low capital cost (compared to other renewable energy options), low operating costs, and technological maturity. Wind power can also be developed in relatively large-scale projects (resources permitting), further reducing costs through economies of scale.

Table C.1: Comparison of Key Clean Energy Technology Options

	Wind Power	Solar PV[a]	Solar Thermal Electric[b]	Geothermal	Solid Biomass	Waste to Energy	Landfill Gas/Biogas	CHP
Typical Size Project	5–200 MW	0.1–1 MW	25kW–50 MW	5–100 MW	5–50 MW	5–50 MW	1–10 MW	25 kW–500 MW
Approximate U.S. Market Size (installed capacity in MW)	9,149[c]	300[d]	350	2,400[e]	6,500[f]	2,500[f]	1,200[f]	81,000
Typical Total Installed Cost ($/kW)[g]	1,200	6,000–8,000	3,900	2,350	1,500–2,500	4,000–6,000	1,300–1,500	800–2,500[h]
Typical Levelized Cost of Electricity Without Incentives in 2005 (¢/kWh)[i]	6–7	30–50	13	5	8.5–11	Varies[j]	4.5	5–9
Typical Levelized Cost of Electricity with Incentives in 2005 (¢/kWh)[k]	2.5–3.5	12–17	9	4	7.5–10	Varies[j]	3.5	Varies[j]

a Assumes PV is for distributed applications (e.g., residential and commercial rooftop applications) that compete with retail electric rates.
b Assumes solar thermal is the parabolic trough technology; a centralized solar concentrating system which produces electricity.
c Source: AWEA 2006 (data are for the end of 2005).
d Source: Navigant 2005.
e Source: Lund 2004.
f Sources: EIA 2004d, Kiser and Zannes 2004, EPA 2005.
g Source: Navigant 2005.
h Fuel cell CHP may be as high as 6,000.
i Source: Levelized Cost of Energy (LCOE) figures are from a proprietary Navigant Consulting model. Assumes projects are developer- (i.e., private sector) financed. Projects that are developed by municipal utilities or similar public sector entities can have lower LCOEs due to lower financing costs. However, there are also fewer financial incentives for public sector-funded projects.
j Cost of energy is highly dependent on tipping fees.
k The LCOE, as calculated with incentives, includes the range of current federal and state incentives applicable to the different technology options (e.g. production tax credit [PTC], investment tax credit [ITC], accelerated depreciation, rebates, state property tax exemptions). It does not include revenue impacts from the sale of renewable energy certificates, emission set-side programs, or other similar programs.

Although cost-competitiveness can vary depending on wind speed (also called "wind class"), the United States has many excellent wind sites where new installations can be developed cost-effectively. However, good wind sites are often located in remote areas where the transmission system is weak, requiring system upgrades and line extensions to transport power to load centers. This additional cost can adversely affect project economics and is currently a key focus of policymakers. Other challenges include the intermittent nature of wind and output variability (i.e., electricity is generated only when the wind blows) and the periodic lapsing and reinstatement of a key federal incentive, the production tax credit (PTC). The PTC, currently set at 1.9¢/kilowatt-hour (kWh) for 10 years of output and available through December 31, 2007, has helped close the economic gap of cost-effectiveness for many installations.

At the state level, incentives focus on property tax or sales tax credits and exemptions rather than on support for demonstration programs or for developing new technologies. Wind energy technology has also benefited from state renewable portfolio standards (RPS) that require a certain percentage of new generation to come from renewable resources. Because wind is one of the lowest-cost renewable options available to utilities and electricity suppliers, it has been used to meet a large portion of RPS renewable energy requirements and is expected to play a major role in the future.

Solar Photovoltaics (PV)

PV technology, which directly converts sunlight to electricity in a solid-state device, is also a fairly mature technology with more than 25 years of proven field performance. Compared to wind power, PV output is more predictable and is often coincident with utility load profiles (e.g., PV output is often highest on hot, sunny days, when demand for power is also highest). Thus, PV can provide peak electric load reduction, which may have a higher value than base load demand. Price reductions for PV systems have historically been 4% to 5% per year on average, and this trend is expected to continue (Navigant 2004a). PV is also one of the few renewable energy technologies that can be customer-sited; therefore, the technology can compete with retail electric rates as opposed to the lower wholesale rates with which centralized systems compete.

Nevertheless, electricity from PV is at least two to three times more expensive than U.S. retail electricity rates because the first cost of PV installation is relatively high. To address the first-cost issue, most state support for PV focuses on buy-down programs or rebates that help lower the high, up-front capital cost. In many states, buy-downs will be slowly phased out as PV systems become more economically viable and as the technology becomes self-sustaining in the marketplace. In addition to buy-downs, some states offer property and sales tax credits for PV, as well as grants to support industry infrastructure development (e.g., installer networks).

Solar Thermal

Solar thermal electric plants convert sunlight into electricity by concentrating sunlight onto working fluids, heating them to high temperatures. The fluids are then used to run conventional turbine-generators or heat engines. Plants potentially have high coincidence between peak output and peak demand, and large plants can take advantage of thermal storage to stabilize output and increase operating flexibility.

Larger central station options include parabolic troughs and power towers. Parabolic troughs use a heat transfer fluid that is heated as it circulates through the receivers and returns to a series of heat exchangers at a central location where the fluid is used to generate high-pressure superheated steam. The steam is then fed to a conventional steam turbine/generator to produce electricity. Power towers use fields of "mirrors" (or heliostats) to concentrate sunlight onto a central receiver tower; the energy can be concentrated as much as 1,500 times that of the energy coming in from the sun.

A smaller distributed power option is the dish Stirling engine/turbine, which involves a parabolic-shaped solar concentrator that reflects solar radiation onto a receiver. The collected heat is used directly by a heat engine to generate electricity.

Of these three solar thermal options, states have had the greatest field experience with parabolic troughs (e.g., 350 megawatts [MW] is currently operating in California). The key challenge today is the high capital cost. Solar thermal plant technology is currently not competitive with conventional power options and therefore state support is typically provided in the form of buy-downs or rebates. Some states also have solar set-asides within their RPS programs, which reserve a portion of the RPS target specifically for solar energy.

Solid Biomass

Broadly speaking, solid biomass is any form of organic matter, including wood, wood waste (e.g., sawdust, bark), agricultural residues (e.g., rice husks, wheat straw), construction and demolition debris, and animal waste (e.g., chicken litter). The single largest source of biomass today is the pulp and paper industry, which uses residues from papermaking to meet approximately 50% of its own energy needs.

Solid biomass technologies produce electricity by direct combustion or by combustion of gas derived from these fuels (i.e., co-firing). With direct combustion, biomass is burned in a boiler to produce high-pressure steam, which is then expanded through a steam turbine to generate electricity. Biomass co-firing with coal in existing coal plants is another potentially attractive option. To date, co-firing has been successfully demonstrated in a number of utility boilers, but only a few co-fired systems are in true commercial operation. Nevertheless, the technology is considered mature, and its deployment is likely to increase in those states that include it in their RPS.

The main advantages of solid biomass power are that it is a baseload resource and that it often converts a waste product into useful electricity and thermal energy. The main disadvantages are fuel price and availability, two issues not faced by other renewable energy options. Emissions and permitting are also more challenging for biomass than for other renewables. Some states support biomass applications through tax incentives and rebates. Direct combustion of solid biomass is also eligible in most state RPS programs.

Geothermal Power

Geothermal power converts heat from within the Earth's crust into electricity using well-proven and mature turbine-generator technology. The United States is currently the world leader in terms of total installed capacity. Unlike wind and solar technologies, geothermal is a baseload resource and can achieve very high annual capacity factors that improve overall economics. Geothermal power plants also have a small physical footprint and minimal environmental impacts. The best geothermal resources, however, are limited to a handful of Western states. In addition, finding good resources with good access to the transmission system can be an issue. Because of its more limited overall potential and mature economics, many state programs do not support the technology with direct financial incentives. Nevertheless, geothermal power is an eligible resource in a number of RPS programs, and untapped resources can be potentially developed. In the long term, a new technology called hot-dry rock could broaden the application of geothermal power.

Waste-to-Energy (WTE)

WTE facilities operate based on the same basic principle as solid biomass combustion facilities but use urban refuse (i.e., municipal solid waste) as fuel. WTE facilities, however, require boiler systems designed to handle a more heterogeneous, low-quality fuel, and the emissions control systems are designed to remove contaminants contained in municipal solid waste. WTE plants are also designed to recover noncombustible materials (e.g., glass, metals) either before or after combustion, depending on the plant design.

The key advantages of WTE technology are the steady supply of fuel and the benefits of waste reduction. The key challenges of WTE plants are high capital and operating costs, siting difficulties (mainly due to emissions issues), and the strong dependence on tipping fee revenue for favorable overall economics. States also have differing perspectives on whether WTE facilities qualify as "renewable" and if so, whether they can be used for RPS compliance. For both biomass and wastes, commercialization efforts are underway for next-generation technologies, such as biomass gasification and pyrolysis.[52] Successful commercial-scale demonstration programs are needed to provide market confidence in these technologies.

Landfill Gas (LFG) and Biogas

LFG and biogas are mixtures of approximately 50% to 60% methane and 40% to 50% carbon dioxide. They are the product of anaerobic digestion.[53] LFG is created as waste decomposes in the anaerobic environment of the landfill. For biogas derived from animal waste management and sewage, anaerobic digestion occurs in manmade digesters[54] as part of the overall process of treating these wastes.

The main advantages of biogas and LFG technologies are that they provide a steady supply of renewable fuels, make use of a low- or zero-cost feedstock, and involve moderate capital costs. As such, the economics are often favorable, even without incentives. These technologies also make use of mature power generation technologies (e.g., internal combustion engines, gas turbines, and boilers/steam turbines). LFG and biogas have also been successfully demonstrated with microturbines and fuel cells. Using biogas and LFG to produce electricity provides many environmental and economic benefits. Anaerobic digester systems for animal waste reduce odors and pathogens, improve water quality, reduce methane emissions, and improve farm revenues through energy self-sufficiency and the ability to use or sell the dried solid residues as fertilizer or animal bedding. Combusting LFG will reduce landfill odor (EPA 2005), methane emissions (landfills are the largest anthropogenic source of methane), and toxic organic compounds.

The main disadvantages of LFG and biogas applications are the relatively small scale of the applications and air permitting issues. Compared with other renewable energy options, the total market potential is relatively small. Some states directly support LFG and biogas with grants and incentives, and LFG and biogas are eligible resources within most state RPS programs.

Combined Heat and Power (CHP)

CHP, also known as cogeneration, is an efficient, clean, and reliable approach to generating simultaneous power and thermal energy from a single fuel source. CHP is not a specific technology but an efficient application of technologies to meet an energy user's needs. CHP uses waste heat from electricity generation to produce useful thermal energy for process heat and space heating or cooling for commercial and industrial facilities. A CHP system is substantially more efficient than purchasing electricity from the grid and generating thermal energy with a boiler or process heater.

A CHP system consists of a number of individual components—a prime mover (heat engine), a generator, heat recovery, and electrical interconnection—configured into an integrated system. The type of equipment that drives the overall system (i.e., the prime mover) typically identifies the CHP system. Prime movers for CHP systems include reciprocating engines, combustion or gas turbines, steam turbines, microturbines, and fuel cells. These prime movers are capable of burning a variety of fuels (e.g., natural gas, coal, oil, and alternative fuels) to produce shaft power or mechanical energy. Although mechanical energy from the prime mover is most often used to drive a generator to produce electricity, it can also be used to drive rotating equipment such as compressors, pumps, and fans. Thermal energy from the system can be used in direct process applications or indirectly to produce steam, hot water, process heat for drying, or chilled water for process cooling.

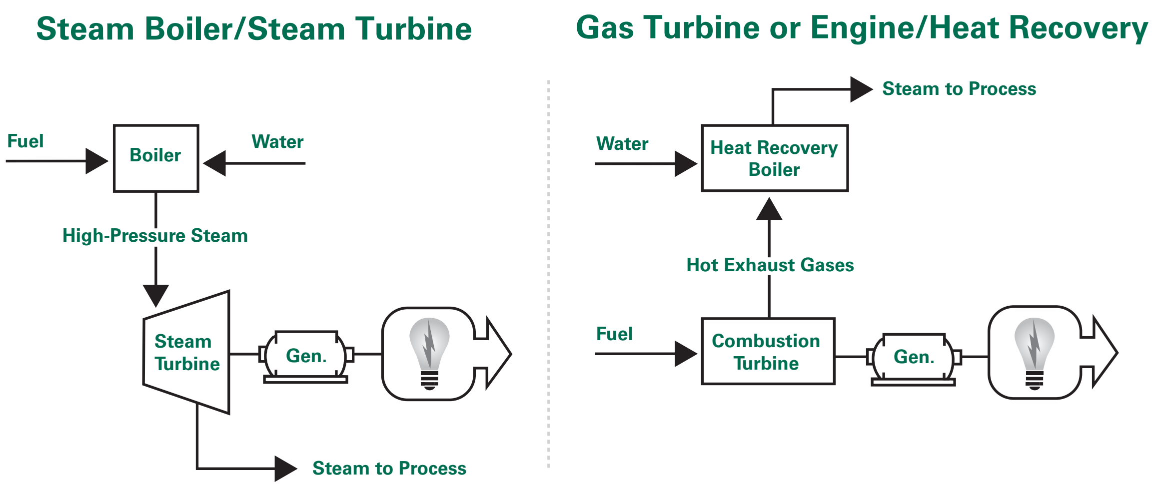
Figure C.1 shows two common configurations for CHP systems: (1) steam boiler/steam turbine, and (2) gas turbine or engine/heat recovery. Historically, the steam boiler/turbine approach has been the most

52 Pyrolysis is the rapid heating and cooling of biomass in the absence of air. It results in a complex liquid hydrocarbon mixture (pyrolysis oils) somewhat similar to crude oil, gaseous compounds such as hydrogen, methane, and carbon (i.e., char).

53 Anaerobic digestion is the conversion of organic material to biogas by microorganisms in the absence of oxygen.

54 With animal waste and wastewater, digesters (typically enclosed concrete structures) are required to contain the organic material and serve as a home for the microorganisms. In comparison, with LFG the biogas is produced naturally in the landfill over a period of years as the organic material slowly decomposes.

Figure C.1: Typical CHP Configurations



Source: EPA 2004.

widely used CHP system. In this approach, a boiler makes high-pressure steam that is fed to a turbine to produce electricity. The turbine is designed so that steam is left over to feed an industrial or other thermal process. Thus, one fuel input to the boiler supplies both electric and thermal energy by recovering waste heat from the steam turbine electric generator. This type of system typically generates about five times as much thermal energy as electric energy. Steam boiler/turbine systems are widely used in the paper, chemical, and refining industries, especially when waste or byproduct fuel exists that can be used to fuel the boiler.

Another common CHP configuration involves a combustion turbine or reciprocating engine to generate electricity. In these applications, thermal energy is recovered from the exhaust stream to make steam or to supply other thermal uses. These CHP systems can use very large (i.e., hundreds of MW) gas turbines, very small (i.e., tens of kilowatts [kW]) microturbines, engines, or fuel cell systems. In these systems, the thermal energy is typically one to two times the electric energy.

Clean Energy Markets

This section describes the current market for renewable energy technologies and CHP, including the growing competitiveness of renewable energy technologies and the proven track record of CHP applications in delivering cost-competitive energy. This clean energy market growth is leading to a range of local economic, environmental, and energy security benefits.

Renewable Energy Technologies

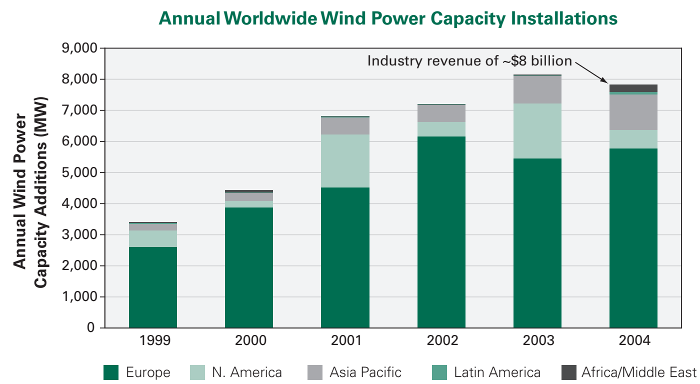
Renewable energy technologies are increasingly cost competitive and are becoming more established in the marketplace. As the opportunities and market have grown, especially over the last five years, large corporations have become major players in the renewable energy industry, bringing additional investment capital, expertise, and capabilities that have spurred further market growth. At the same time, both governments and consumers are placing value on the attributes associated with renewable energy. Many consumers have demonstrated a willingness to pay a premium for renewable energy, and many are able to enroll in voluntary green power programs.

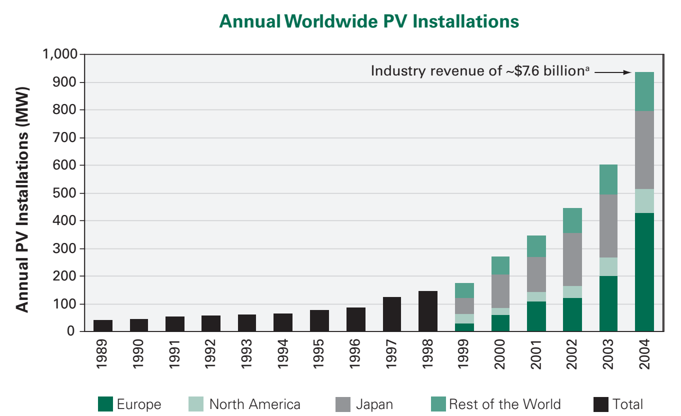
Governments are using incentives and other policy tools, such as RPS, to increase the amount of renewable energy produced. Renewable energy certificates (RECs), also called green tags, green certificates, and tradable renewable certificates, have emerged as the "currency" to both monetize and transact (i.e., trade and sell) the value of the attributes provided by electricity generated with renewable energy. The emergence of both "compliance" (e.g., RPS) and "voluntary" (e.g., green power) markets for renewable energy and renewable energy attributes, facilitated by the emergence of RECs, has changed the renewable energy marketplace and set the stage for future growth.

Both the wind and solar PV markets have experienced double-digit growth over the past decade, primarily as result of the increased demand for renewable energy. Globally, PV has had a 40% compounded annual growth rate (CAGR) since 1999. In 2004, the market was valued at approximately $7.6 billion per year from equipment sales and installation. The wind industry has undergone similar growth. Wind energy installations worldwide have experienced a 24% CAGR since 1999 (see Figure C.2) (Navigant 2005b).

In the United States, annual installations of renewable energy (excluding large-scale hydroelectric plants) have been between 600 MW and 1,700 MW per year between 2001 and 2003 (EIA 2004b). (Fluctuations during this period are primarily the result of changing government incentives.) As shown in Figure C.3, renewable energy (excluding large-scale hydroelectric plants) accounted for 2.2% of electricity consumption in 2003 (EIA 2004a, EIA 2004c). Today, hydropower and biomass, including WTE and LFG, dominate the renewable energy market in the United States. Annual installations of renewable energy (excluding large-scale hydro) in the United States are expected to reach more than 4,500 MW per year by 2015 in a business-as-usual scenario, resulting in an $8 billion market annually from equipment (Navigant 2005b).

Figure C.2: Annual Worldwide Installations for Wind Power and PV

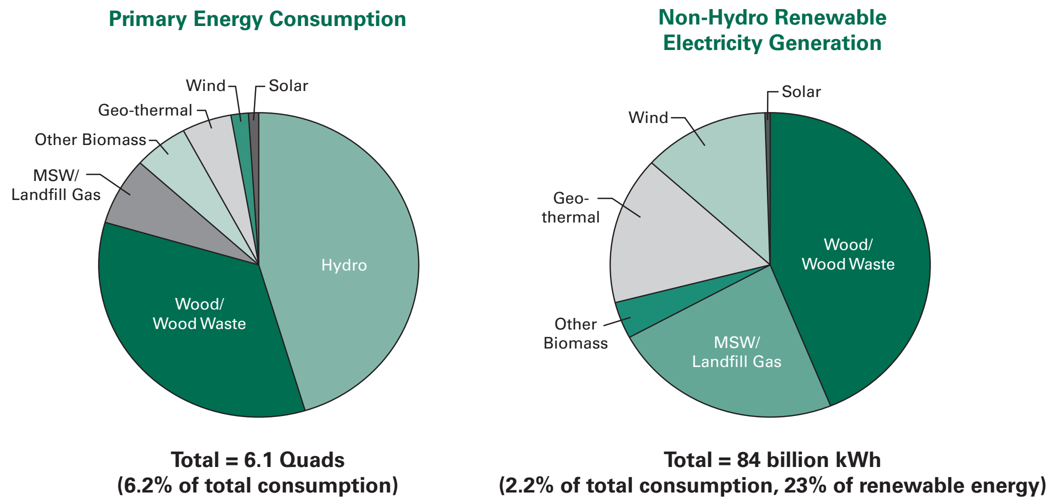




[a] Based on the total installed cost of systems.

Source: Navigant 2005b.

Figure C.3: U.S. Renewable Energy Snapshot *(2003 Data)*



Sources: EIA 2004a, EIA 2004c.

Combined Heat and Power (CHP)

Interest in CHP technologies has been growing among energy customers, regulators, legislators, and developers for a variety of reasons, including electric industry deregulation, environmental concerns, and unease over energy security. The growth of CHP has been fairly constant (with a slightly slower growth rate in the past few years) since the implementation of the Public Utilities Regulatory Policy Act (PURPA) in 1978, which created various incentives for CHP. PURPA has become somewhat less important in states with restructured electric markets but still provides some important support for CHP in regulated states. The U.S. CHP inventory in 2004 was 80.9 gigawatts (GW) at 2,845 sites. As shown in Figure C.4, almost 90% of this capacity is in the industrial sector, with about one-third of the total capacity in the chemical industry alone. The refining and paper industries make up another 25% of the total.

With recent increases in the price of natural gas and uncertainty in future prices, interest in CHP projects fueled by waste and opportunity fuels, such as landfill and digester gas, refinery gas, and wood waste, is growing.

Market Challenges Affecting Clean Energy Technologies

Because of their improving economics and performance, renewable energy technologies are becoming increasingly viable alternatives to conventional power generation technologies. Nevertheless, renewable technologies continue to face persistent market challenges that impede their growth and acceptance. Similarly, while CHP utilizes commercially proven technologies with higher efficiencies that can make it economically attractive, a variety of market, institutional, and regulatory barriers can slow its growth.

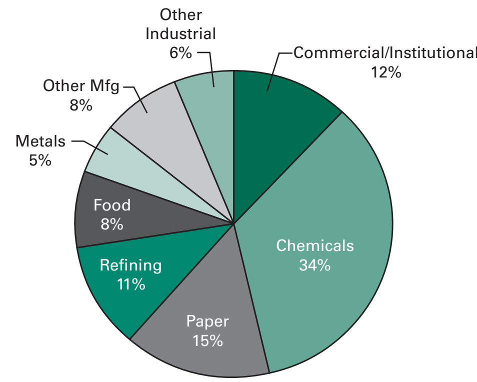
Renewable Energy

Key market challenges faced by renewable energy technologies include:

- High first costs compared with competing technologies.
- Grid integration issues related to the interconnection of distributed technologies and connecting resources in remote locations.
- A lack of maturity of other needed "infrastructure," such as sales, installation, and service.
- A need for more consumer education about the benefits of renewable energy.
- The lack of maturity and liquidity in emerging REC markets.
- Public concerns over aesthetics, noise, and environmental impacts related to certain technologies.

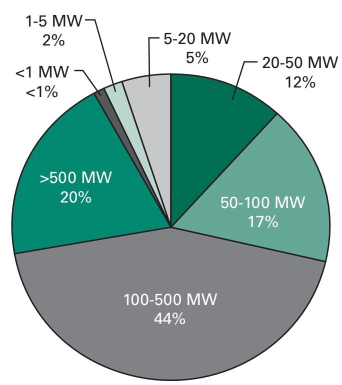
Recognizing the benefits of renewable energy to their constituents, many states are implementing a range of programs, including RPS, net metering, and public benefits funds, to address these challenges. For example, Pennsylvania is advancing renewable energy through its Energy Harvest Grant Program and Alternative Energy Portfolio Standard.

Figure C.4: U.S. CHP Capacity *(2004)*



Source: EEA 2004.

Figure C.5: Size Distribution of U.S. CHP Projects *(2004)*



Source: EEA 2004.

Combined Heat and Power (CHP)

Key market challenges faced by CHP include:

- CHP systems entail larger up-front capital investment, more complicated operation and maintenance (O&M) procedures, and higher O&M costs than conventional generation systems. These issues can be especially difficult for small to medium CHP users (i.e., less than 5 MW), who are less able to bear the additional cost and risk of onsite generation, regardless of the efficiency and environmental benefits.
- Rate-setting and regulation of interconnection are critical factors in the success of CHP. Uneconomical partial-load rates, such as standby or buy-back rates, exit fees, and interconnection requirements, can limit CHP's economic viability.
- Utilities can reduce the economic attractiveness of CHP projects by offering special low electric rates to the potential energy user that reduce the economic benefits of CHP.
- Although CHP typically provides an overall environmental benefit, it can increase the onsite emissions at the CHP facility. While this increase is typically offset by a greater decrease at another location (e.g., the power generator), most environmental regulations are not designed to recognize this benefit.

These potentially higher capital and operating costs and structural barriers are offset by the benefits of lower energy costs and increased power reliability where new CHP projects are being constructed. In addition, state policies (such as output-based regulations, interconnection standards, and public benefits funds) that reduce institutional, regulatory, and structural barriers to CHP and recognize its economic and environmental benefits are important components in addressing these challenges. For example, Connecticut has created an output-based regulation for small distributed generators for several pollutants, and has included CHP as an eligible resource for the state RPS.

Emerging and Innovative Clean Energy Supply Policies

State governments are crafting policies to reduce market and institutional barriers for clean energy technologies and accelerate their adoption in the marketplace. The *Guide to Action* focuses on established policies that have proven to be successful in various states. The following table describes emerging and innovative clean energy supply policies not covered in the *Guide to Action* and provides sources of additional information about these policies.

Table C.2: Emerging and Innovative Clean Energy Supply Policies

Policy	Description	For More Information
Contractor and Equipment Certification	Some states require equipment and contractor certification for renewable energy installations that receive buy-downs or state financial incentives. These standards ensure that high-quality products and services are provided to customers.	The North American Board of Certified Energy Practitioners (NABCEP) works with the renewable energy and energy efficiency industries, professionals, and stakeholders to develop and implement quality credentialing and certification programs for practitioners. http://www.nabcep.org/ In New York, NYSERDA's PV or Solar Electric Incentive Program provides cash incentives for the installation of small PV or solar-electric systems. The cash incentives are only available for PV systems purchased through an eligible installer. http://www.powernaturally.org/Programs/Solar/incentives.asp?i=1
Emissions Disclosure/Generation Disclosure	Similar to the nutritional dietary information found on most food packages, this policy would include a chart in every monthly bill that describes the sources of electricity generation and their emissions.	More than 20 states have some form of electricity label. Information on the Massachusetts program can be found at: http://www.mass.gov/dte/restruct/competition/info_disclosure_2001.htm
Content Requirements for Certain Electricity Contracts (Wholesale)	When a state enters into new contracts for purchasing power or is in the position to approve long-term contracts, the state can require that a certain percentage of the electricity generated is from renewable energy sources or meets thresholds for energy efficiency.	NY Executive Order 111 requires state agencies to purchase 10% of their electricity from renewable sources in 2005 and 20% by 2010. http://www.gorr.state.ny.us/gorr/EO111_fulltext.htm
Loading Order	A Public Utility Commission (PUC) can specify a certain sequence of technologies and resources that would be considered for meeting new electricity demand. Any deviation from this loading order would require utilities to explain the reason for this deviation to the PUC. This policy may need to be combined with others (such as simplified air emissions credits for energy efficiency, renewable energy, and distributed generation) in order to make it profitable or economical to utilities.	California's Energy Action Plan requires utilities to prioritize their resource procurements by following an established "loading order." http://irecusa.org/articles/static/1/1102615783_1018302029.html http://www.energy.ca.gov/energy_action_plan/index.html http://www.cpuc.ca.gov/static/energy/electric/energy+action+plan/
Standard REC Trading/Tracking Systems	A few state renewable energy programs currently have Web-based tracking systems for DG and/or assigning RECs based on this generation. These systems enable DG systems to participate in REC markets.	New Jersey established a separate REC trading system for solar PV. http://www.njcep.com/srec/

(continued on next page)

Table C.2: Emerging and Innovative Clean Energy Supply Policies (*continued*)

Policy	Description	For More Information
Mandated Long-Term Contracts for Renewables	This policy allows utilities in deregulated markets to sign long-term contracts with renewable energy generators. This would provide generators with the long-term certainty they need to obtain project financing.	The Colorado referendum that created the state's RPS requires a 20-year purchase for projects eligible to satisfy the RPS. http://www.dora.state.co.us/puc/rulemaking/Amendment37.htm A legislative act in Connecticut requires distribution companies to sign long-term Power Purchase Agreements for clean energy for no less than 10 years at a wholesale market price plus up to $0.055 per kWh for the REC. http://www.ctcleanenergy.com/investment/MarketSupplyInitiative.html
Builder/Building Incentives	Utilities and states can provide incentives for the construction and operation of energy-efficient and renewable energy homes and buildings (e.g., quicker and less expensive permits for homes with solar power).	Duke Energy lowered electric rates for ENERGY STAR-qualified homes. http://www.dukepower.com/ http://www.dukepower.com/news/releases/2005/feb/2005022201.asp New Jersey offers Solar PV rebates (ranging from $3.06/watt to $5.30/watt) to residential, commercial, and industrial applicants. http://www.njcep.com/html/2_incent.html
Utility Procurement Programs for DG	The PUC can require utilities to purchase or promote the installation of DG to meet increasing electricity demands. Renewable energy DG could be given preferential treatment in this program to promote reductions in carbon emissions. This would be similar to RPS.	The California Public Utilities Commission (CPUC) requires utilities to consider DG (customer- or utility-owned) as an alternative to distribution investments. http://www.cpuc.ca.gov/PUBLISHED/FINAL_DECISION/24136.htm
Integrating PUC goals into PBF Program Design (i.e., "Cross Walking")	This policy encourages the use of public benefits funds (PBFs) not only to support energy efficiency and renewable energy, but to help PUCs and utilities reach their goals (e.g., increased reliability, congestion relief, and permanent peak reduction).	New England Demand Response Initiative http://nedri.raabassociates.org/index.asp In Massachusetts, annual peak demand reductions from energy efficiency and PBF-funded load management ranged from 98 MW to 135 MW in 1998, 1999, and 2000. Cumulative reductions from these programs reached 700 MW (7.2% of peak) as of 2000. http://eetd.lbl.gov/EA/EMP/reports/PUB5482.pdf
Transparent Distribution Planning	Currently, the electricity distribution company primarily conducts distribution planning without outside feedback that could lead to lower-cost alternative solutions or taking into account other decisionmaking criteria. A transparent distribution planning process could allow customers and developers to align their investments with the greatest system need. In addition, the utility would benefit from customer response to the system need.	The California Energy Commission (CEC) is working with CPUC to create a transparent distribution planning process. http://www.energy.ca.gov/energypolicy/index.html

Source: Compiled by EPA based on multiple sources.

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